

Management of organic solid waste from rail operation by the Vietnam railways: the current situation and possible solutions

Hiện trạng và giải pháp quản lý rác thải hữu cơ trên đường sắt Việt nam

Research article

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The quick social economic development of Vietnam stimulates great demand of quality as well as quantity on transport service by the increasingly growing needs of customer for transportation. The railway passenger transport is currently still an important branch of a country's transport system because it is safer, more eco-friendly and much more efficient in comparison to another means. However, the increasing of the number of passengers is the main causes of fast increasing waste amount from the rail service. The aim of this paper is to study how the organic waste from rail service is managed and treated today by the Vietnam railways. The paper ends with some proposal solutions for treating and disposing of organic waste by applying renewable energy technologies for climate change mitigation to protect human health and the environment.

Sự phát triển nhanh chóng của nền kinh tế Việt nam dẫn đến nhu cầu vận chuyển hành khách ngày càng tăng mạnh về số lượng cũng như chất lượng dịch vụ. Vận chuyển hành khách bằng đường sắt hiện tại ở Việt nam vẫn đóng vai trò quan trọng trong hệ thống vận tải quốc gia do lợi thế an toàn cao, thân thiện với môi trường và lợi ích cao của nó so với các phương tiện khác. Tuy nhiên sự biến động lớn của lượng hành khách đi tàu là nguyên nhân làm cho lượng rác thải từ các dịch vụ đường sắt cũng tăng mạnh. Bài báo tập trung vào nghiên cứu và làm rõ hiện trạng quản lý chất thải hữu cơ trên đường sắt Việt nam hiện nay cũng như các chiến lược nhằm xử lý chất thải hữu cơ, sử dụng công nghệ năng lượng tái tạo nhằm bảo vệ môi trường, giảm thiểu biến đổi khí hậu.

Keywords: organic waste, railway waste, waste management, Vietnam railway

1. Introduction

Generally, rail operation may cause many kinds of wastes mainly disposed of by passenger rail service and by passenger terminals. The types and amount of waste depend totally on the number of passengers handled and the services provided (IFC, 2007). The solid waste generated from trains and passenger train terminals in Vietnam includes food waste, paper and newspaper, a variety of used plastic bags and plastic water bottles, beer cans, disposable food containers, in addition is a big volume of human waste from passengers on trains. The management of this waste source by the Vietnam Railway Cooperation is becoming extremely imperative at present time because the volume of waste is growing more and more.

2. Organic waste from passenger rail service

Vietnam railway currently has a total length of about 3000 km including 7 routes. The system is organized at two levels: the Thong Nhat route (from Hanoi to Ho Chi Minh City) and the regional level. According to the statistical report of the Vietnam Railways (2012), daily on the longest route Thong Nhat (of more than 1,700 kilometres long) in 2011 there were 18 - 33 Thong Nhat passenger trains and 10 regional trains in operation carrying approximately 13,700 passengers. The trip from Hanoi to Ho Chi Minh City is usually 29 to 44 hours. The rest 6 routes with the trips lasting from 4 to 8-hours carried about 16,200 passengers per day. One of the main reasons of a enormous amount of waste from passenger trains is that, there is a large number of 300 up to 700 of passengers on a train, the duration of journey is too long, as well as there

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is lack of understanding of environmental protection from the passengers, and in additional the eating habits of local people.

The organic wastes from passenger rail service on trains include:

- Disposable food containers: milk cartons, tea bags, coffee grounds, etc.
- Human waste: passenger's urine and feces
- Food waste from food establishments: vegetables, fruit peel, meat, poultry, seafood, rice, etc.
- Paper and newspaper: napkins, paper towels, paper plates, paper toilet, etc.

2.1 Food, paper and food containers

Food, paper and food containers are mostly brought with on board by passengers or by service on trains. They are almost not properly collected after use. On express trains (written as SE) these wastes are collected in waste containers or manual by conductors without separation. The collected waste will be gotten down to stop stations, loaded up into waste-carrying vehicles and taken to landfills. On regional trains, because windows are openable, a volume of waste is thrown directly and indiscriminately along the sides of the railroad by passengers. It causes pollution not only to landscape and ecological environment along the railway but also to water sources. A typi-

cal example for this problem is illustrated in Figure 1.



Figure 1. Waste from train beside the railroad

According to the survey and statistical data of the Vietnam Railway (TRICC_JSC, 2009), amount of living activity solid wastes disposed of by passenger trains service was estimated to be about 1.1 kg/passenger/trip day, nearly 40% of which were organic wastes. In 2011 total of solid organic waste from all Vietnamese passenger trains was calculated based on the annual statistic data of the Vietnam Railways and listed in the Table 1.

Table 1. Organic waste from trains per year

| Train route | Number of wagons per train | Maximum number of passengers per train | Total number of passengers in the year 2011** | Organic waste from passenger trains | | |
|------------------|----------------------------|--|---|-------------------------------------|-------------------------|--------------|
| | | | | Food, paper, food box (ton) | Urine (m ³) | Faeces (ton) |
| Thong Nhat train | 12 | 500 | 4,320,856 | 1,723 | 4,269 | 1,002 |
| Regional train | 14 | 700 | 7,006,015 | 2,803 | 6,922 | 1,626 |
| Total | | | 11,326,871 | 4,526 | 11,191 | 2,628 |

** Source: The Statistical Report of Vietnam Railway Cooperation, 2011 (Vietnam Railways, 2011)

2.2 Passenger's human waste

One of considerable problems is that how human waste disposed of by passengers on trains will be treated. The research on the environmental management in rail (TRICC_JSC, 2009) showed that in average, a passenger excreted about 0.988 liters of urine and 0.232 kg of faeces per day. In general, passenger's waste treated under sanitary technologies shows many limitations, it is carried out only on several new wagons with small scale.

During the past periods of time, all passengers' waste was untreated and disposed of directly from trains on railroad. At present, only 70 (make up about 6.77%) from total 1034 passenger wagons are equipped with smart septic tank Biofast of the company PETECH. Therefore, the current applied management method of 95.23% of human waste is still disposal of from trains on the rail. It is also revealed that about untreated 1066 m³ urine and 431 tons faeces are daily disposed of in territories. This current disposal method has led to numerous environmental and social problems.

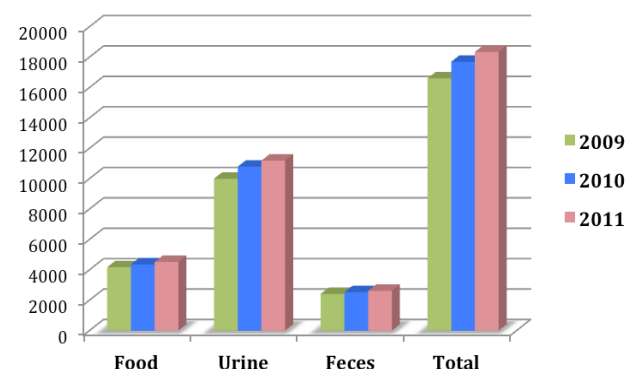


Figure 2. Comparison of organic wastes by year

The main environmental impacts are pollution to soil, surface and underground water source. It was found that, year-to-year the volume of organic and human wastes generated by passenger activities on trains is expanding considerably. Figure 2 shows the comparison of generated organic waste from Vietnam railway from 2009 to 2011 (Vietnam Railways, 2009, 2010, 2011).

3. Organic waste from passenger terminals

There are in total 278 railway stations in Vietnam (The Vietnam Railways, 2012), all of them are provided passenger operations and service. The organic waste generated from passenger terminals consists:

- Waste generated from passengers waiting for the train;
- Waste generated from terminal's activities;
- Waste taken from stationed trains.

At stations, food, paper and also other wastes, except human waste are disposed of in railroad, because all toilets have to be closed when trains stop in accordance with the Vietnam railway rules and regulations (see Figure 3). However, inside stations many waste containers are provided for waste collection without classification. At the large passenger stations as Hanoi and Saigon main stations there are station's groups of garbage collectors, who will remove waste containers and often classify recyclable and reproductive wastes, then sell them to recycling facilities. The rest wastes will be loaded up into waste vehicles of Public Urban Environment Companies and sent to landfill or treatment facilities once daily.

Human waste inside stations is collected by pipes into sewerage system of urban for treatment or disposal of. The research on the environmental management in rail (TRICC_JSC, 2009) was summarized, that volume of generating living solid wastes at whole passenger stations in Vietnam is about 18.9 tons/day. Forecast to 2015 it will be 23 tons/day, among which about 8.5 tons to 13 tons are organic solid wastes. Therefore, the whole volume of organic wastes from passenger trains and terminals in Vietnam exceeds 30,000 tons per year.



Figure 3. Waste from train at Hanoi main station

4. Solution to organic waste management for the Vietnam railways

Facing the problem of municipal waste disposal in order to reduce environmental burden, there are different approaches to manage organic waste, including:

- Landfill;
- Incineration;

- Composting;
- Anaerobic digestion.

Landfill is not sustainable in Vietnam because it leads to rapid depletion of the limited landfill space and formation of green house gases such as methane, and wastewater at landfills, imposing severe burden on environment.

Aiming at sustainable development the organic waste as an alternative source of renewable energy has to be re-used. Composting and anaerobic digestion are the most favored options that were commonly also successfully used in other developing countries as China, Nepal, India (Müller, 2007); and nowadays they are started being used in some urban and rural areas of Vietnam.

Adopting the innovative biological technologies - composting and anaerobic digestion is a suggestion for the Vietnam Railways to assure cost-efficiency and sustainability in long-term management of organic waste from passenger operations and services. The technologies are used to convert the organic waste to useful compost products and produce biogas for energy recovery, concurrently reduce fossil CO₂-emissions. Biogas is recovered and transformed into heat or any other form of energy. The remaining digested material is a nutrient rich fertilizer and can be used in agriculture. Today there is a large number of different types and designs of anaerobic digester technologies for the treatment of organic waste available, depending on feedstock material type, the composition of the substrate and the volume of the waste stream.

It is recognized that decomposition of one metric ton of food can potentially release up to 500 m³ of methane (equivalent to 0.43 ton of petrol) (Holliger, 2008). So if the food waste from railway in Vietnam is converted into energy through anaerobic digestion technology, it will release approximately 2,262,500 m³ of methane (equivalent 1,945.25 ton of petrol) per year. For example, the well-known and reliable DRANCO technology by Company OWS (DRANCO, 2012) can release 100 to 200 Nm³ of biogas per ton of waste and 220 to 440 kWh of electricity production per ton of waste. So over 30,000 ton of organic waste per year from the railway of Vietnam (see Table 1) can be turned to 3 million to 6 million Nm³ of biogas and total power generation capacity will be 6.6 MWh to 13.2 MWh through the DRANCO process - that is the meaningful numbers for developing country as Vietnam.

Nowadays many composting plants for waste treatment have been constructed in some urban and rural areas of Vietnam. A successful biological treatment of organic waste from railways at these plants plays a significant role is source-separation of waste on trains and at passenger stations by the Vietnam Railways. In general, some solutions are suggested to management of waste from railway service:

- Developing regulations of collection, storage, transportation and processing of waste in railway of Vietnam
- All wagons and passenger terminals should be supplied with waste containers to classify waste on trains

- Encouragement of passenger train operators to segregate wastes in the trains by separating the collection of food, papers, plastic and metallic containers
- Toilets of all wagons of trains should be installed with septic tank Biofast to collect the passenger's human wastes
- All collected separated wastes from passenger trains and terminals will be loaded up into waste vehicles and sent to biological treatment facilities.

In summary, the current living organic waste management of the Vietnam Railways is unsatisfactory and needs to be addressed in a dire way. Investment for organic waste treatment by biological technologies has a central meaning and requires tasks of the Vietnam Railways nowadays for promotion of the urban agricultural activities on green space, protection of environment and for sustainable development.

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